Pneumorrhachis Following Lumbar Puncture: A Case Report

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We report a rare case of pneumorrhachis following lumbar puncture. A 4-year-old boy was admitted to our hospital with seizures following a head injury and upper respiratory infection. Lumbar puncture was performed to rule out central nervous system infection. In response to leg pain and weakness a few hours after the procedure, lumbar spine computed tomography (CT) revealed pneumorrhachis at the level of L5-S1. In a follow-up CT scan 3 days later, the pneumorrhachis resolved spontaneously. Pneumorrhachis following diagnostic lumbar puncture is an extremely rare condition. We discuss pneumorrhachis and review cases in the literature.

Key Words: pneumorrhachis, lumbar puncture
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Lumbar puncture is a common procedure for diagnostic and therapeutic purposes in pediatric neurology. Although it is a minor procedure, complications including headache, traumatic tap, dry tap, pain referred to lower limbs, herniation syndromes, intraspinal epidermoid tumor, and retroperitoneal abscess have been reported [1]. Pneumorrhachis — air within the spinal canal — has been reported following epidural anesthesia [2], spontaneous pneumomediastinum [3], traumatic pneumothorax [4], skull fracture [5], radiation therapy, and thoracic surgery [6]. However, it is very rare after a diagnostic lumbar puncture. We report a case of pneumorrhachis following diagnostic lumbar puncture.

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Case Presentation

A 4-year-old boy was transferred to our hospital after two episodes of generalized tonic-clonic seizures, following a prodromal head injury and upper respiratory infection lasting 3 days. Brain computed tomography (CT), performed in the referral hospital, revealed no evidence of intracranial hemorrhage. Physical examinations, including meningeal signs such as neck stiffness, Kernig's sign, and Brudzinski's sign were all unremarkable. Laboratory examinations demonstrated mild leukocytosis with white blood cell count of 13,760 cells/μL. Other basic chemistry results (C-reactive protein, sodium, potassium, chloride, glucose, blood urea nitrogen, creatinine, glutamic-oxaloacetic transaminase, glutamic-pyruvic transaminase) were normal. Progressive drowsiness was noticed in the pediatric intensive care unit. Thus, central nervous system infection was suspected, even though no definite meningeal signs were observed. Upon confirmation of no papilledema, lumbar puncture was performed under the formal standard procedure. Briefly, Citosol (thiamylal sodium) was given intravenously for

sedation and the patient quickly fell asleep, without fighting or crying. The patient was placed in the lateral recumbent position, and a 22-gauge needle was inserted into the L3-L4 intervertebral space. A dry tap was encountered on the first lumbar puncture, but the second one was uneventful. Cerebrospinal fluid examination revealed no blood cells, either white blood cells or red blood cells. Glucose and protein concentrations were all within normal limits (81 and 9 mg/dL, respectively). No bacteria or viruses were isolated. Unfortunately, a few hours after lumbar puncture, pain and decreased muscle power developed in both legs. Other neurologic examinations, including deep tendon reflexes, sensation, and bladder function, were unremarkable. Therefore, lumbar CT was recommended to rule out a space-occupying lesion. Surprisingly, air bubbles in the spinal canal at the level of the L5-S1 spine were found on the lumbar spine CT scan (Figure 1A–C).

Three days later, with conservative treatment and bedrest, the boy's leg pain improved and his muscle power returned to normal. The follow-up CT scan revealed that the air bubbles had disappeared (Figure 1D–F). No significant sequelae were found at a 1-month follow-up.

Discussion

Pneumorrhachis following a diagnostic lumbar puncture is an extremely rare condition. Few cases have been reported after therapeutic tapping, such as epidural analgesia. This case, as far as we know, is the first report of pneumorrhachis after a diagnostic lumbar tap. Generally, pneumorrhachis can be divided by location into epidural and subarachnoid pneumorrhachis. In epidural pneumorrhachis, the symptoms vary depending on the underlying condition. Symptomatic epidural pneumorrhachis in trauma patients has never been reported [7]. Neurologic deficit as a complication of epidural pneumorrhachis has, however, been reported in patients after administration of epidural analgesia [2]. As compared with the amount of epidural air seen in trauma patients, a larger volume of air may be injected into the epidural space using the 'loss-of-resistance' technique when administering epidural analgesia [8]. These patients have been reported to complain of lumbar root compression syndrome, including paresthesia, weakness, and buttock and leg pain [2,9].

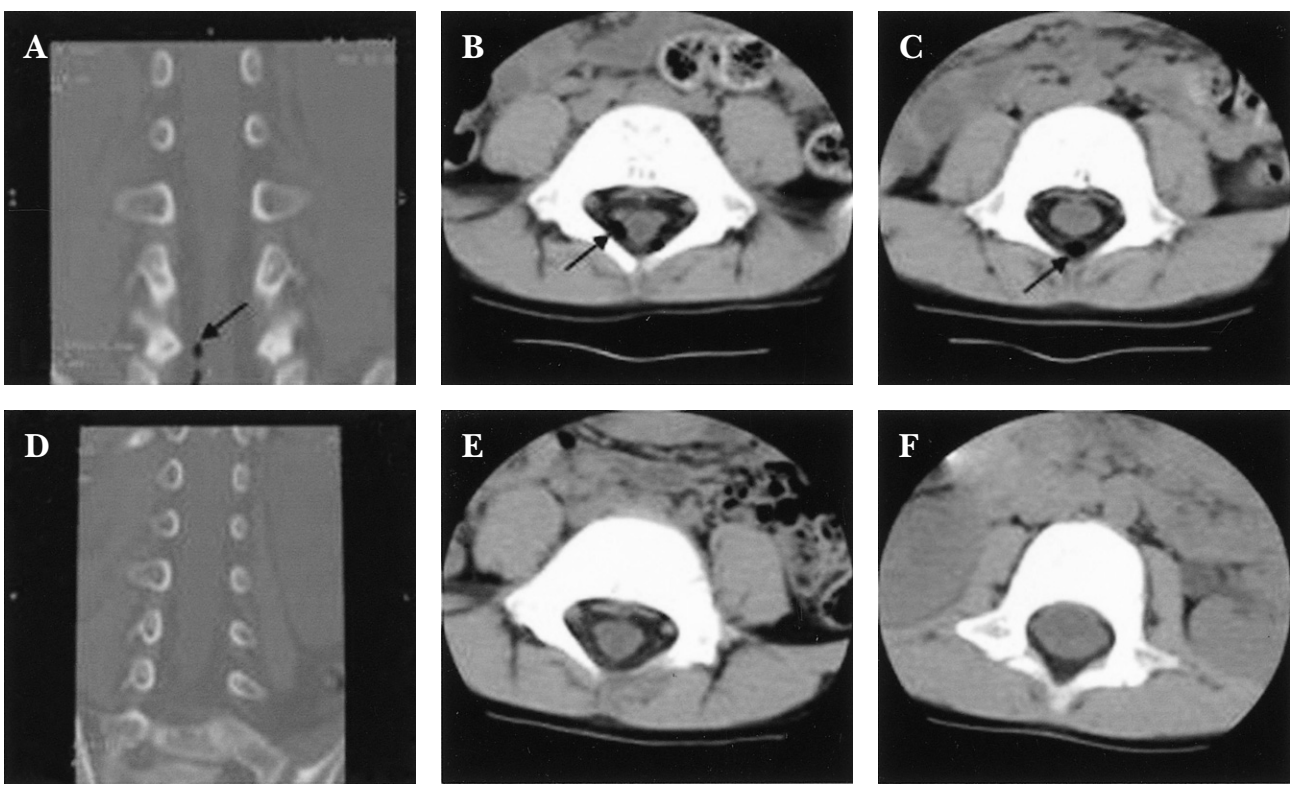

Figure 1. *Lumbosacral computed tomography (CT) scan of a 4-year-old patient. (A–C) One day after lumbar puncture, CT scan shows a small amount of air in the spinal canal (arrows). (D–F) Three days later, CT scan shows spontaneous resolution of the condition.*

As compared with epidural pneumorrhachis, air in the subarachnoid space is frequently associated with more severe injury. Subarachnoid space pneumorrhachis has been reported in association with thoracotomy, traumatic pneumothorax, thoracic spine trauma, thoracic spine surgery, skull fracture, advanced lung carcinoma, extended beam radiation therapy, and advanced esophageal carcinoma [6,10–16]. Air entering the subarachnoid space easily travels the cephalad to the cranium. Therefore, subarachnoid pneumorrhachis is almost always associated with pneumocephalus [7]. Occasionally, meningitis also occurs in subarachnoid pneumorrhachis due to a torn dura [7]. These patients experience severe headaches, or less often, focal neurologic symptoms similar to a stroke [17].

In this patient, the major clinical complaints were weakness and pain of both legs, without headache or meningismus. These complaints are compatible with those noticed in epidural pneumorrhachis. Pneumorrhachis is better demonstrated on CT scan but may also be detected by magnetic resonance imaging or spine radiography. Even with a CT scan it may be difficult to distinguish whether the air is in the epidural or subarachnoid space or not [4]. In our patient, one view appears to show an air bubble in the epidural space (Figure 1C), whereas in another view the air bubble appears to be in the subarachnoid space (Figure 1B). Therefore, a combination of epidural and subarachnoid pneumorrhachis could not be ruled out in our patient.

The management of pneumorrhachis must be individualized. Patients with epidural air secondary to more severe underlying conditions, such as dural-enteric fistulas, would require urgent intervention to prevent significant morbidity or even mortality [18]. However, epidural pneumorrhachis almost always resolves spontaneously with no neurologic sequelae, as with our patient. In contrast, spontaneous resolution of subarachnoid space pneumorrhachis is less frequent. Surgical intervention is more likely to be necessary in these patients. Although differentiation is difficult, we should try to localize the air as precisely as possible.

The reason that this patient suffered from pneumorrhachis is still a mystery. From the literature, dissemination of the air of pneumomediastinum or pneumothorax along fascial planes from the posterior mediastinum through the neural foramina into the epidural space has been reported [19]. Still another report revealed that air may be injected into the epidural space using the 'loss-of-resistance' technique when administering epidural analgesia [8]. In our patient, we performed the lumbar tap with the patient under general anesthesia using a standard method with a 22-gauge needle, which is regularly used in children. The stylet-free needle is the only route we could consider to allow air into the spinal canal. Because the pressure in the epidural space is much lower than that in the subarachnoid space, atmospheric air passing through the stylet-free puncture needle enters more easily into the epidural space. This might be the mechanism that caused the pneumorrhachis in our patient.

Conclusions

Pneumorrhachis, mostly self-limited, can induce tension pneumocephalus and meningitis. It is very important to obtain an early diagnosis and identify the underlying cause. Although its occurrence is extremely rare, pneumorrhachis should be taken into consideration when children complain of low leg pain and weakness after undergoing a nontraumatic lumbar puncture.

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腰椎穿刺後產生的椎管積氣 — 病例報告

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在執行腰椎穿刺後的椎管積氣極為少見，本篇是報告一位四歲的小男孩在頭部外傷及上呼吸道感染後產生痙攣，腦部電腦斷層檢查並無顱內出血的現象，由於懷疑有中樞神經感染他接受了腰椎穿刺，之後病患有下肢疼痛及無力的現象，經腰薦椎電腦斷層檢查有椎管積氣，於是我們使用支持性療法並請病患臥床休息，三天後，病患的臨床症狀及電腦斷層檢查都已恢復正常，因腰椎穿刺後的椎管積氣極為少見，故我們提出這個病例報告並做歷史的文獻回顧。

關鍵詞：椎管積氣，腰椎穿刺

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